CLAIM AMENDMENTS

The following is a complete list of claims. The claims below replace all prior versions of the claims in the application. Pease amend claims 1, 3, 4, 5, 7, 8, 15, 16, 17, 24, 27, 48, 49 – 52 and 58.

1. (Currently Amended) An apparatus to determine the proximity of a dental instrument to a tooth's apical foramen while the instrument is in the tooth's canal, the apparatus comprising:

a handpiece that includes:

a dental instrument operable to remove tissue from a tooth of the patient,

a handpiece driver mechanically coupled to the dental instrument and operable to drive the dental instrument to remove tissue, and

an electrically conductive path that includes at least a portion of the mechanical coupling between the dental instrument and the handpiece driver;

a signal generator coupleable to body tissue of a patient and to the handpiece, ~~a dental instrument that is operable to remove tissue from a tooth of the patient,~~ wherein, while the signal generator is coupled to the body tissue and the handpiece, ~~instrument,~~ the signal generator generates a voltage signal across the body tissue and the electrically conductive path; and ~~instrument; and~~

a microprocessor coupleable to the dental handpiece ~~instrument~~ and that, while coupled to the dental handpiece ~~instrument~~ and while the instrument removes tissue from the patient's tooth,

senses the voltage signal after the voltage signal has been modified by the impedance of the patient's body,

demodulates the modified voltage signal to isolate the modified voltage signal from electrical noise <u>received via the electrically conductive path between the dental instrument and the handpiece driver, and</u> ~~generated by the dental instrument, and~~

compares the modified voltage signal to the voltage signal generated by the signal generator.

2. (Previously Presented) The apparatus of claim 1, wherein the voltage signal includes an amplitude and a frequency.

3. (Currently Amended) The apparatus of claim 1, wherein:

   the voltage signal has an amplitude and a frequency, and

   the <u>micro</u>processor compares the amplitude of the voltage signal generated by the signal generator to the amplitude of the modified voltage signal.

4. (Currently Amended) The apparatus of claim 1, further comprising a reference impedance coupled to the signal generator and the <u>handpiece</u> ~~dental instrument~~ such that the reference impedance and the <u>handpiece</u> ~~dental instrument~~ are arranged in series relative to each other, and the signal generator generates a voltage signal across the combination of <u>the</u> reference impedance, the <u>handpiece</u> ~~dental instrument~~ and the body tissue, wherein the reference impedance is known.

5. (Currently Amended) The apparatus of claim 1, wherein in response to comparing the modified voltage signal to the voltage signal generated by the signal generator, the <u>micro</u>processor generates a proximity signal that represents the proximity of the dental instrument to the tooth's apical foramen.

6. (Previously Presented) The apparatus of claim 1, further comprising an analog-to-digital converter that digitizes the modified voltage signal.

7. (Currently Amended) The apparatus of claim 1, wherein:

   the voltage signal has an amplitude and a frequency, and

the microprocessor determines the phase of the modified voltage signal relative to the voltage signal generated by the signal generator.

8. (Currently Amended) An apparatus to indicate the proximity of a dental instrument to a tooth's apical foramen while the instrument is in the tooth's root canal, the apparatus comprising:

a handpiece that includes:

a dental instrument operable to remove tissue from a tooth of the patient,

a handpiece driver mechanically coupled to the dental instrument and operable to drive the dental instrument to remove tissue, and

an electrically conductive path that includes at least a portion of the mechanical coupling between the dental instrument and the handpiece driver;

a first lead operable to couple the apparatus to the handpiece, ~~a dental instrument,~~ and including a second node;

a second lead operable to couple the apparatus to body tissue of a patient and including a third node, wherein the body tissue has an impedance;

a known reference impedance coupled to the first lead such that while the first lead is coupled to the handpiece ~~dental instrument~~ and the second lead is coupled to the body tissue, the reference impedance, handpiece, ~~instrument,~~ and body tissue are arranged in series relative to each other;

a signal generator coupled to the reference impedance and the second lead, wherein the coupling between the signal generator and the reference impedance includes a first node, the signal generator operable to generate a divider signal across the combination of the reference impedance, the electrically conductive path, ~~dental instrument,~~ and body tissue, and wherein the reference impedance is operable to modify the divider signal;

a <u>micro</u>processor that includes a storage, is coupled to the second node, and that, while the first lead is coupled to the dental instrument, the second lead is coupled to the body tissue, and the instrument removes tissue from the patient's tooth, the <u>micro</u>processor<u>:</u>

samples and demodulates a stimulation signal that includes the divider signal modified by the reference impedance and the body tissue's impedance, and that includes electrical noise <u>received via the electrically conductive path between the dental instrument and the handpiece driver;</u> ~~generated by the dental instrument;~~

compares the demodulated stimulation signal to the divider signal;

stores at least one lookup table that correlates at least one signal comparison with a proximity of the dental instrument to the apical foramen; and

generates a proximity signal from the lookup table; and

a proximity indicator that indicates the proximity of the dental instrument to the tooth's apical foramen.

9. (Previously Presented) The apparatus of claim 8, wherein the divider signal includes an amplitude and a frequency.

10. – 11. (Cancelled)

12. (Original) The apparatus of claim 8, wherein the reference impedance essentially consists of a resistive element.

13. (Original) The apparatus of claim 8, wherein the reference impedance comprises a resistive element and a reactive element.

14. (Original) The apparatus of claim 8, further including a signal conditioner.

15. (Currently Amended) The apparatus of claim 14, wherein the signal conditioner includes a low-pass noise filter coupled between the second node and the <u>micro</u>processor.

16. (Currently Amended) The apparatus of claim 14, wherein the signal conditioner includes an amplifier coupled between the second node and the <u>micro</u>processor.

17. (Currently Amended) The apparatus of claim 8, wherein the <u>micro</u>processor performs at least one of the following: a synchronous demodulation algorithm, a fast Fourier transform, a single frequency fast Fourier transform, and a convolving algorithm, to demodulate the stimulation signal from electrical noise <u>received via the electrically conductive path between the dental instrument and the handpiece driver.</u> ~~generated by the dental instrument.~~

18. (Previously Presented) The apparatus of claim 8, wherein the lookup table includes an empirical element derived from observation of the divider signal and the stimulation signal as a function of proximity of the dental instrument to the apical foramen in teeth other than teeth of the patient.

19. (Original) The apparatus of claim 8, wherein the proximity indicator includes a digital display.

20. (Previously Presented) The apparatus of claim 19, wherein the digital display displays digits representing a relative proximity to the apical foramen.

21. (Previously Presented) The apparatus of claim 19, wherein the digital display displays digits representing a distance to the apical foramen in a unit-of-measure.

22. (Original) The apparatus of claim 8, wherein the proximity indicator includes a haptic device.

23. (Cancelled)

24. (Currently Amended) The apparatus of claim 8, wherein the <u>micro</u>processor updates the proximity signal.

25. (Cancelled)

26. (Original) The apparatus of claim 8, wherein the divider signal consists essentially of a single frequency.

27. (Currently Amended) A method for indicating the proximity of a dental instrument to a tooth's apical foramen, the method comprising:

generating a divider signal across a combination of a reference impedance, body tissue of a patient, and a handpiece that includes a dental instrument disposed in the tooth's root canal, a handpiece driver mechanically coupled to the dental instrument to drive the instrument, and an electrically conductive path that includes at least a portion of the mechanical coupling between the driver and instrument, ~~and body tissue of a patient,~~ wherein the combination includes the reference impedance, the handpiece's electrically conductive path ~~instrument~~ and the body tissue arranged in series relative to each other;

impeding the signal with the reference impedance;

further impeding the signal with the body tissue;

sampling and demodulating a stimulation signal that includes the divider signal modified by the body tissue's impedance, and that includes electrical noise received via the electrically conductive path; ~~generated by the dental instrument as the instrument operates;~~

comparing the demodulated stimulation signal to the divider signal;

based on the comparison, generating a proximity signal; and

based on the proximity signal, indicating a proximity of the dental instrument to the apical foramen.

28. (Previously Presented) The method of claim 27, wherein generating the divider signal includes generating a signal that includes an amplitude and a frequency.

29. – 30. (Cancelled)

31. (Previously Presented) The method of claim 27, wherein demodulating the stimulation signal includes filtering noise from the stimulation signal.

32. (Previously Presented) The method of claim 27, wherein sampling the stimulation signal includes amplifying the stimulation signal.

33. (Previously Presented) The method of claim 27, wherein indicating the proximity of the dental instrument to the apical foramen includes updating the proximity signal.

34. – 35. (Cancelled)

36. (Previously Presented) The method of claim 27, wherein the divider signal consists essentially of a single frequency.

37. – 46. (Cancelled)

47. (Previously Presented) The apparatus of claim 5 wherein the proximity signal is generated from a look-up table that is stored in the apparatus.

48. (Currently Amended) The apparatus of claim 5 wherein the proximity signal is generated from an equation that is stored in the apparatus and executed by the microprocessor.

49. (Currently Amended) The apparatus of claim 1 wherein the microprocessor executes a synchronous demodulation algorithm to demodulate the modified voltage signal from electrical noise received via the electrically conductive path between the dental instrument and the handpiece driver. ~~generated by the dental instrument.~~

50. (Currently Amended) The apparatus of claim 1 wherein the microprocessor performs a fast Fourier transform of the modified voltage signal to demodulate the modified voltage signal from electrical noise received via the electrically conductive path between the dental instrument and the handpiece driver. ~~generated by the dental instrument.~~

51. (Currently Amended) The apparatus of claim 1 wherein the microprocessor performs a single-frequency fast Fourier transform of the modified voltage signal to demodulate the modified voltage signal from electrical noise received via the electrically conductive path between the dental instrument and the handpiece driver. ~~generated by the dental instrument.~~

52. (Currently Amended) The apparatus of claim 1 wherein the microprocessor executes a convolving algorithm to demodulate the modified voltage signal from

electrical noise received via the electrically conductive path between the dental instrument and the handpiece driver. ~~generated by the dental instrument.~~

53. (Previously Presented) The method of claim 27 wherein the reference impedance includes a resistive element.

54. (Previously Presented) The method of claim 27 wherein the reference impedance includes a reactive element.

55. (Previously Presented) The method of claim 27 wherein demodulating the stimulation signal includes performing at least one of the following: a synchronous demodulation algorithm, a fast Fourier transform, a single frequency fast Fourier transform, and a convolving algorithm.

56. (Previously Presented) The method of claim 27 wherein generating a proximity signal includes retrieving data from a lookup table that correlates at least one signal comparison with a proximity of the dental instrument to the apical foramen.

57. (Previously Presented) The method of claim 27 wherein generating a proximity signal includes executing an equation that correlates at least one signal comparison with a proximity of the dental instrument to the apical foramen.

58. (Currently Amended) A method for indicating the proximity of a dental instrument to a tooth's apical foramen, the method comprising:

generating a voltage signal across a combination of body tissue of a patient and a handpiece that includes a dental instrument disposed in the tooth's root canal, a handpiece driver mechanically coupled to the dental instrument to drive the instrument, and an electrically conductive path that includes at least a portion of the mechanical coupling between the driver and instrument, ~~and body tissue of a patient,~~ wherein the combination includes the hanpiece's electrically conductive path ~~instrument~~ and the body tissue arranged in series relative to each other;

impeding the signal with the body tissue;

while the dental instrument removes tissue from the tooth, sensing the voltage signal after the voltage signal has been modified by the impedance of the patient's body tissue;

demodulating the modified voltage signal to isolate the modified voltage signal from electrical noise received via the electrically conductive path; and ~~generated by the dental instrument; and~~

comparing the modified voltage signal to the generated voltage signal.

59. (Previously Presented) The method of claim 58, wherein generating the voltage signal includes generating a signal that includes an amplitude and a frequency.

60. (Previously Presented) The method of claim 58, wherein the voltage signal consists essentially of a single frequency.

61. (Previously Presented) The method of claim 59 wherein comparing the modified voltage signal to the generated voltage signal includes comparing their amplitudes.

62. (Previously Presented) The method of claim 59 wherein comparing the modified voltage signal to the generated voltage signal includes comparing the phase of the modified voltage signal relative to the phase of the generated voltage signal.

63. (Previously Presented) The method of claim 59 wherein comparing the modified voltage signal to the generated voltage signal includes comparing their amplitudes and the phase of the modified voltage signal relative to the phase of the generated voltage signal.

64. (Previously Presented) The method of claim 58, wherein sensing the modified voltage signal includes amplifying the modified voltage signal.

65. (Previously Presented) The method of claim 58, wherein demodulating the modified voltage signal includes filtering noise from the modified voltage signal.

66. (Previously Presented) The method of claim 58 wherein demodulating the modified voltage signal includes performing at least one of the following: a

synchronous demodulation algorithm, a fast Fourier transform, a single frequency fast Fourier transform, and a convolving algorithm.

67. (Previously Presented) The method of claim 58 further comprising generating a proximity signal based on the signal comparison.

68. (Previously Presented) The method of claim 67 further comprising indicating a proximity of the dental instrument to the apical foramen based on the proximity signal.

69. (Previously Presented) The method of claim 67 wherein generating a proximity signal includes retrieving data from a lookup table that correlates at least one signal comparison with a proximity of the dental instrument to the apical foramen.

70. (Previously Presented) The method of claim 67 wherein generating a proximity signal includes executing an equation that correlates at least one signal comparison with a proximity of the dental instrument to the apical foramen.

71. (Previously Presented) The method of claim 67, wherein indicating the proximity of the dental instrument to the apical foramen includes updating the proximity signal.